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(19)

(54) IMPROVEMENTS IN OR RELATING TO LIQUID PRESSURE CONTROL SYSTEMS

(71) We, AUTOMOTIVE PRODUCTS LIMITED, a British Company of Tachbrook Road, Leamington Spa, Warwickshire, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to liquid pressure control systems and has for its object to provide a simple and relatively cheap liquid pressure control system particularly suitable for use in motor vehicles for clutch disengagement purposes, though it may also be used for other purposes such as, for example, for controlling the throttle valve of a carburettor.

It has already been proposed to provide, for clutch operation, a liquid pressure control system comprising two bellows connected by a conduit, the bellows and conduit forming together a sealed system, compression of one bellows by operation of a pedal displacing liquid in the system to expand the other bellows which acts directly or through a lever on a clutch release bearing to disengage a clutch.

In one prior proposal it has been mentioned that expansion and contraction of the liquid in the system will affect the position of the clutch pedal. It is believed that any substantial change of the clutch pedal position due to expansion and contraction of the liquid is undesirable.

According to the present invention there is provided a liquid pressure control system including first and second variable volume chambers the volume of the first of which is decreased by thrust applied to an operating member and increase in the volume of the second of which is adapted to effect displacement of an operated member, the said two variable volume chambers being connected by a conduit and forming with said conduit a sealed system, wherein the materials of which said variable volume chambers and conduit are formed have a coefficient of expansion so related to the coefficient of expansion of the liquid with which the system is filled that the variation of volume of the system as a whole, caused by expansion or contraction of said materials with change in temperature, is substantially the same as the variation of volume of the contained liquid with the same change of temperature.

The variable volume chambers may be defined by cylinder-and-plunger units provided with fluid tight sealing means between each cylinder and its associated plunger.

The fluid tight sealing means may be of the rolling diaphragm type.

A stop may be provided to limit movement of the plunger in the second variable volume chamber in a direction to reduce the volume of that chamber, and a spring is provided which urges that plunger constantly in the volume reducing direction.

A spring may be provided which acts on the operating member to apply a light load to the plunger of the first variable volume chamber in a direction to transmit pressure through the liquid in the system to the plunger of the other variable volume chamber.

In a liquid pressure control system provided with springs as defined in the last two preceding paragraphs, the spring acting on the plunger of the second variable volume chamber may be stronger than the spring acting on the operating member.

In the accompanying drawings:—

Figure 1 is a general view, with some parts shown in section, of one form of liquid pressure control system according to the invention, arranged to effect the release of a friction clutch;

Figure 2 is a view similar to Figure 1, showing a modified liquid pressure control system;

Figure 3 is a sectional elevation, on a larger

scale, of a master cylinder for use in the systems described with reference to Figures 1 and 2; and

Figure 4 is a section on the line 4—4 of Figure 3.

Referring to Figure 1 of the drawings the liquid pressure control system comprises two variable volume chambers shown respectively at 10 and 11 and hereinafter referred to as the master cylinder 10 and the slave cylinder 11.

Each of the said cylinders comprises a cylindrical body 12 made of plastics material and closed at one end by an end plate 13 of the same material welded to the said body. The other end of each body 12 is formed with an internal flange 14. In the bodies 12 of the cylinders 10 and 11 are slidable respectively cup-shaped plungers 15 and 16 each having its open end facing towards the end plate 13 of the cylinder in which it is mounted. A sealed joint between each plunger 15 or 16 and its associated cylinder 10 or 11 is provided by a rolling diaphragm 17, which is a known type of sealing device consisting of a tubular diaphragm folded back on itself and having its ends secured respectively to the cylinder and plunger so that part of the diaphragm adjacent one end lies against the cylinder wall, part of the diaphragm adjacent the other end lies against an external cylindrical wall 18 of the plunger, and the diaphragm material rolls from one such wall to the other as the plunger moves in the cylinder. Figure 3 shows the diaphragm arrangement in a master cylinder, the arrangement in a slave cylinder being similar.

The ends of the cylinders 10 and 11 closed by the end plates 13 are connected one to the other by a conduit 19, preferably flexible and formed of plastics material, the ends of the conduit, as shown in Figure 3, being clamped to nipples 21 on the said end plates.

Each of the plungers 15 and 16, at its closed end, is provided externally with a part-spherical cavity 22 defining a surface slightly greater than a hemisphere, and adapted to receive, as a snap fit therein, a ball head 23 on a push rod. The push rod 24 carrying the ball head 23 engaging the master cylinder plunger 15 is pivotally connected at 25 to a lever 26 carrying a pedal 27 pressure on which urges the plunger 15 towards the closed end of the master cylinder 10 to reduce the liquid-containing volume of that cylinder. The push rod 28 carrying the ball head 23 engaging the slave cylinder plunger 16 acts on a lever 29, pivotally mounted in a clutch bell housing (not shown), and acting on a clutch release bearing 31. As shown in Figure 1, the clutch release bearing acts on fingers 32 of a diaphragm type clutch spring 33 acting in the known manner to clamp a clutch driven plate 34 between a pressure plate 35 and a flywheel driving face 36, but it will be understood that the said release bearing may co-operate with pivoted release levers acting to retract the pressure plate from the flywheel driving face against the load of clutch engaging springs of either the diaphragm or coil type.

The bodies 12 of the master and slave cylinders 10 and 11 are mounted in a vehicle by being located in holes in bulkheads or other sheet metal parts of the vehicle structure, fragments of which are shown at 37 and 38 respectively in Figure 1. The said holes are of a size enabling the cylinder bodies to be passed through them and are each formed with two or more notches, two being shown at 39 in Figure 4, equally spaced around the periphery of the hole. On each cylinder body 12, adjacent the end thereof at which the internal flange 14 is formed, there are provided a number of substantially rigid radial projections 41 equal to the number of notches 39 and, on the side of the projections 41 further from said end of the cylinder, there are provided, as shown in Figures 3 and 4, a plurality of resilient radially projecting ears 42 which are inclined outwardly and towards the projections 41, the said ears 42 being shown in dotted lines in Figure 4. The arrangement is such that, if the internally-flanged end of the cylinder body 12 is passed through one of the receiving holes with the projections 41 thereon aligned with the notches 39, until the said projections lie on the opposite side of the sheet metal part to the ears 42, the said ears are deformed, and rotation of the cylinder to bring the projections 41 out of line with the notches 39 results in the cylinder being firmly held in position.

In the arrangement of the liquid pressure control system shown in Figure 1, a tension spring 43 is mounted between the pedal lever 26 and a fixed anchorage on the bulkhead 37 so as to urge the pedal in a direction to cause the plunger 15 of the master cylinder 10 to tend to reduce the volume of liquid in the master cylinder and thus apply a light load through the liquid pressure control system to the release bearing 31, which thus remains in constant contact with the fingers 32 of the diaphragm type clutch spring 33, or with clutch release levers if they are provided. The clutch release bearing 31 is preferably of the ball-bearing type, since continuous rubbing contact is undesirable with release bearings of the carbon type.

The liquid pressure control system shown in Figure 2 includes all the components shown in Figure 1, the said components bearing the same reference numerals as in Figure 1. In addition, a tension spring 44, stronger than the tension spring 43, is mounted between the lever 29 acting on the release bearing 31 and the part 38 of the vehicle structure, the said spring urging the plunger 16 of the slave cylinder 11 against the end plate 13 of the slave cylinder. The push rod 28 is adjustable in length, and is set to a length such that, when the plunger is in contact with the end plate,

the release bearing 31 is just clear of the diaphragm type clutch spring fingers 32 or of the clutch release levers if the clutch is of a type having such levers. The release bearing thus contacts the fingers or release levers only during a clutch releasing operation, and may be of the carbon type. The length of the push rod 28 may be adjusted from time to time to compensate for wear of the clutch facings.

When a spring 44 such as is shown in Figure 2 is provided, the spring 43 may be omitted, the spring 44, instead of urging the slave cylinder plunger 16 against an abutment, applying pressure through the liquid in the system to the master cylinder plunger 15 to urge that plunger, or the pedal lever to which it is coupled, against a stop.

The cylinders and plungers, and the conduit connecting the cylinders, are made of a plastics material having a coefficient of expansion so related to the coefficient of expansion of the liquid with which the system is filled that the volume of the liquid-containing space in the system increases or decreases with a change of temperature to substantially the same degree as the volume of the liquid, and no substantial relative movement of the plungers occurs even in the event of a large change of temperature.

Examples of plastics materials which may be used are, for the cylinders 10 and 11 glass-filled nylon, for the plungers 15, 16 and rolling diaphragms 17 nylon, acetal resin, polythene or polypropylene, and, for the conduit 19, nylon.

The liquid used in a system in which the components are formed of such materials may be water-based with an anti-freezing and boiling point raising additive such as glycol.

The filling of the system with liquid is carried out in the following manner. It will be observed that the end plates 13 of both the cylinders 10 and 11 are provided with tubular nipples 45, shown as being sealed by welding. When the system is first assembled, the nipples 45 are open, and, to fill the system, one nipple 45 is connected to a source of supply of the liquid to be used in the system, through a stop cock or other shut-off device. Liquid is allowed to flow into and through the system until the liquid issuing from the nipple not connected to the source of supply is seen to be free of air. The flow is then stopped, and the last mentioned nipple sealed by welding. The supply of liquid is then disconnected, and the nipple through which it was connected to the system is similarly sealed by welding.

To enable the relative positions of the plungers in the master and slave cylinders to be adjusted a chamber may be provided, in free communication with one of the said cylinders, the volume of which can be varied by means such as a screw-operated plunger. If the stop limiting movement of the pistons in the direction corresponding to clutch engagement is provided in the master cylinder, and sufficient liquid is contained in the system to hold the slave cylinder piston away from the closed end of the slave cylinder when the clutch facings are unworn, the variable volume chamber can be used as a wear-compensating adjuster, the volume of the said chamber being increased when the clearance at the release bearing is reduced by facing wear, to reduce the quantity of liquid between the pistons.

WHAT WE CLAIM IS:—

1. A liquid pressure control system including first and second variable volume chambers the volume of the first of which is decreased by thrust applied to an operating member and increase in the volume of the second of which is adapted to effect displacement of an operated member, the said two variable volume chambers being connected by a conduit and forming with said conduit a sealed system, wherein the materials of which said variable volume chambers and conduit are formed have a coefficient of expansion so related to the coefficient of expansion of the liquid with which the system is filled that the variation of volume of the system as a whole, caused by expansion or contraction of said materials with change in temperature, is substantially the same as the variation of volume of the contained liquid with the same change of temperature.

2. A liquid pressure control system according to claim 1, wherein the variable volume chambers are defined by cylinder-and-plunger units provided with fluid tight sealing means between each cylinder and its associated plunger.

3. A liquid pressure control system according to claim 2, wherein the fluid-tight sealing means are of the rolling diaphragm type.

4. A liquid pressure control system according to claim 2 or 3, wherein a stop is provided to limit movement of the plunger in the second variable volume chamber in a direction to reduce the volume of that chamber, and a spring is provided which urges that plunger constantly in the volume-reducing direction.

5. A liquid pressure control system according to claim 2 or 3, wherein a spring is provided which acts on the operating member to apply a light load to the plunger of the first variable volume chamber in a direction to transmit pressure through the liquid in the system to the plunger of the other variable volume chamber.

6. A liquid pressure control system according to claims 4 and 5, wherein the spring acting on the plunger of the second variable volume chamber is stronger than the spring acting on the operating member.

7. A liquid pressure control system according to any of claims 2 to 6, wherein the cylinder bodies of the cylinder and plunger units are adapted to be mounted in openings in sheet metal members of a vehicle structure, each said cylinder body having substantially

rigid radial projections to pass through notches around a hole in a sheet metal member when the cylinder body is inserted in said hole, and said cylinder body also having flexible radial projections which, when the rigid radial projections lie on the opposite side of a sheet metal member to said flexible radial projections, are deformed by pressing against said sheet metal member, so that by passing the rigid projections through the notches and rotating the cylinder body the said body is locked in position in the hole.

8. A liquid pressure control system substantially as described with reference to, and as shown in Figure 1 or Figure 2 of the accompanying drawings.

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Sheet 1

FIG.1.

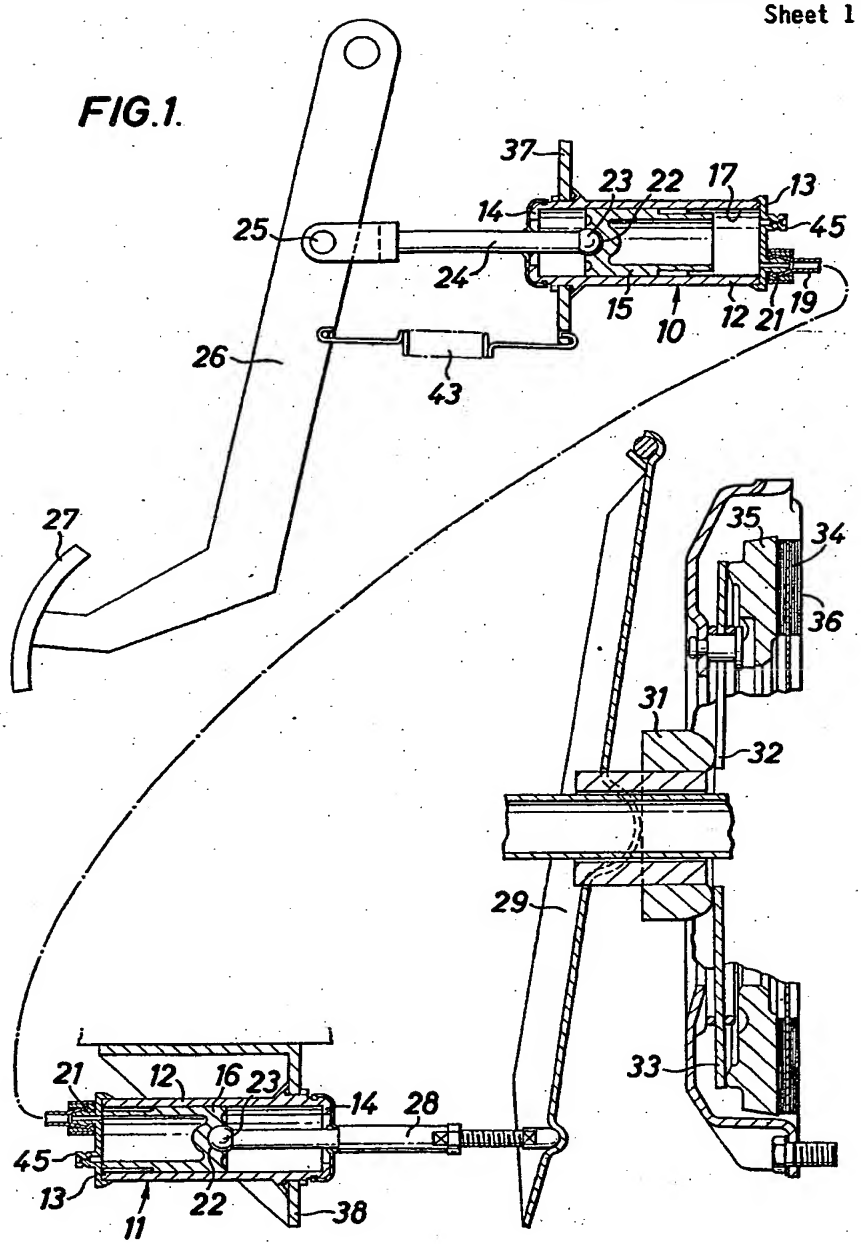

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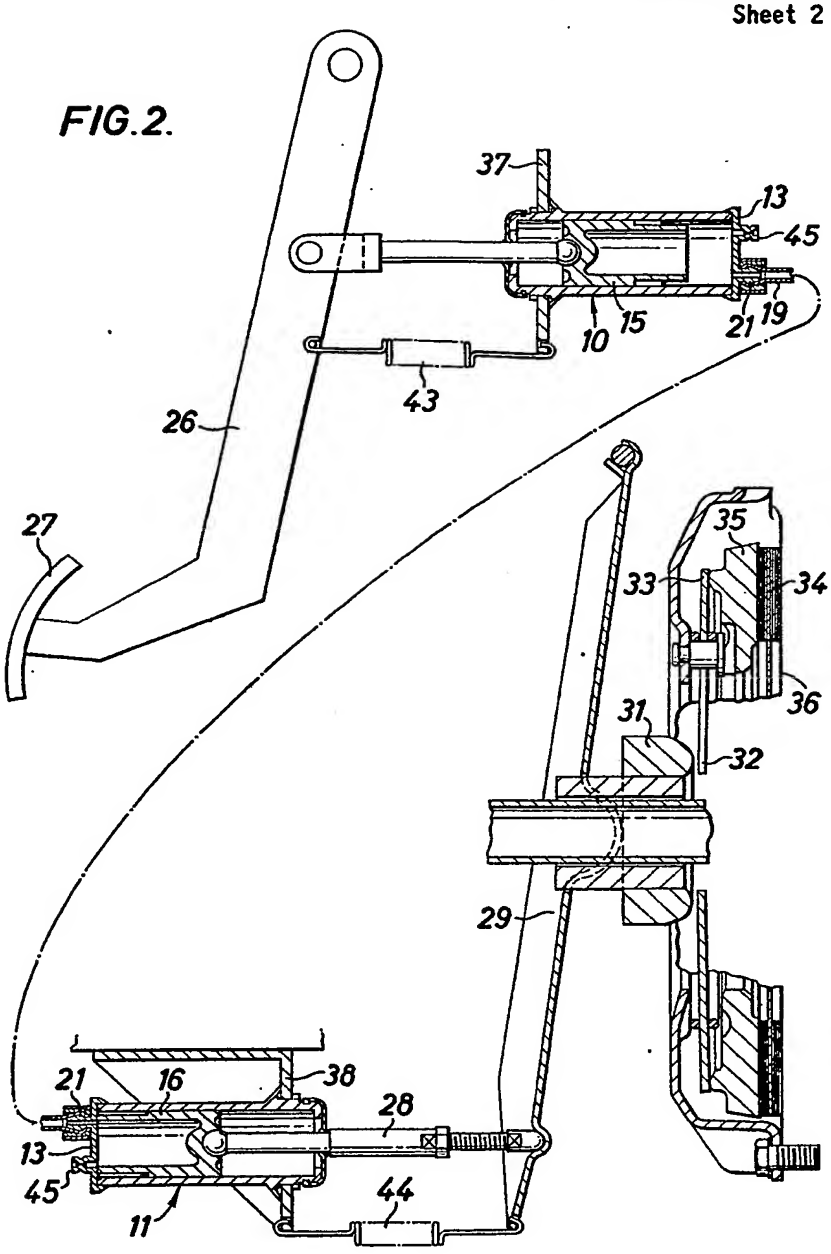
FIG.2.



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Sheet 3

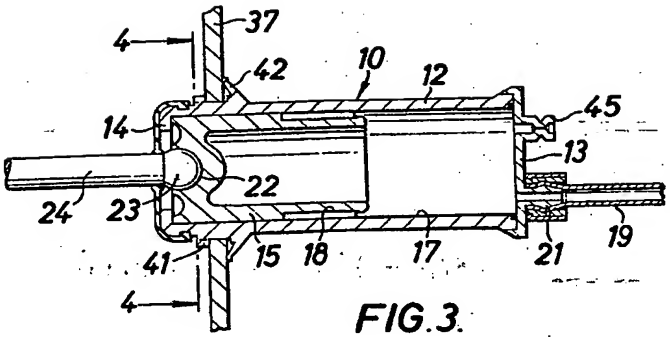

FIG.3.

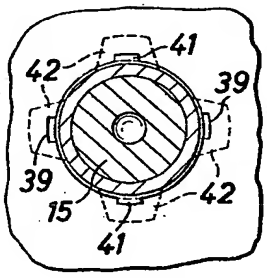

FIG.4.